ESPCI
Laboratoire PMMH
10 rue Vauquelin, 75231 Paris Cedex 05

Séminaire PMMH

Bureau d'Études, Bâtiment L, 2 ème étage

Vendredi 25 avril 2014, 11h00-12h00

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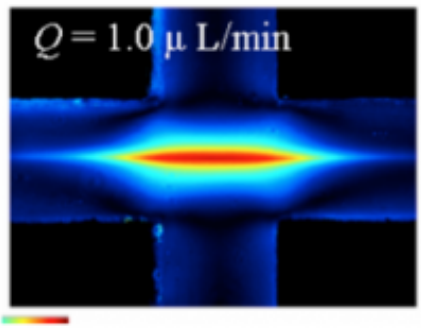
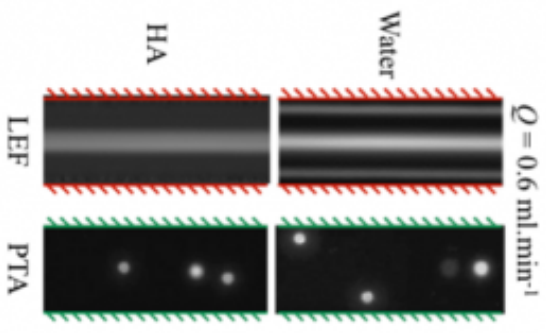
Exploiting and Optimizing Viscoelastic Effects in Microfluidic Flows

I will describe two different scenarios in which viscoelastic effects become extremely important in microfluidic devices and can be exploited to optimize the operation of a proposed microfluidic device. In the first example we consider optimizing the shape of a microfluidic extensional rheometer designed to generate strong extensional deformations that can drive coil-stretch transitions of macromolecules in a homogeneous straining flow. We use flow induced birefringence (FIB) and particle image velocimetry (PIV) to understand the distribution of stresses and kinematics in the resulting device. In the second application we use the strong extensional stresses induced by straining deformations in the wake of solid particles to optimize the performance of a device designed to separate rare circulating cells using particle migration across streamlines. The interaction of inertia and elasticity enables deterministic focusing with high efficiency of beads, deformable cells, and anisotropic hydrogel particles in a microchannel at extremely high flow rates. We show that upon addition of micromolar concentrations of hyaluronic acid (HA), the resulting fluid viscoelasticity can be used to control the focal position of bioparticles at very high throughputs corresponding to Reynolds numbers of up to $Re \approx 10,000$.





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